

CLAIMS

1. A piezo oscillator, characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit;

the quick start-up circuit has a configuration in which an NPN transistor is connected between the power supply voltage Vcc line and one terminal of the piezo resonator in forward polarity, and a capacitor is connected between the power supply voltage Vcc line and the base of the NPN transistor; and

a start-up quickening voltage is applied to the piezo resonator from the power supply voltage Vcc line through the NPN transistor for a predetermined length of time after the application of power supply voltage Vcc.

2. A piezo oscillator, characterized in that;

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit;

the quick start-up circuit has a configuration in which a first NPN transistor is connected between the power supply voltage Vcc line and one terminal of the piezo resonator in forward polarity, a resistor is connected between the base and the emitter of the first NPN transistor, a second NPN transistor is connected to the power supply voltage Vcc line and the base of the first NPN transistor in forward polarity, and a capacitor is connected between the power supply voltage Vcc line and the base of the second NPN transistor; and

a start-up quickening voltage is applied to the piezo resonator from the power supply voltage Vcc line through the NPN transistor for a predetermined length of time after the application of power supply voltage Vcc.

5 3. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit; (19)

the quick start-up circuit has a configuration in which a PNP transistor is connected between the power supply voltage Vcc line and one terminal of the piezo resonator in forward polarity, and a capacitor and a diode are connected in parallel between the base of the PNP transistor and the ground; and

a start-up quickening voltage is applied to the piezo resonator from the power supply voltage Vcc line through the NPN transistor for a predetermined length of time after the application of power supply voltage Vcc.

4. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc; and

the quick start-up circuit begins to operate with a delay determined according to the rise of voltage of the power supply voltage Vcc after the application of the power supply voltage Vcc and outputs the start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc.

5. A piezo oscillator characterized in that:

the piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

5 the quick start-up circuit having a transistor switch and a voltage dividing circuit for base biasing of the transistor switch; and

the quick start-up circuit begins to operate at the timing controlled by the voltage division ratio of the voltage dividing circuit after the application of the power supply voltage Vcc and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc.

6. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

the quick start-up circuit having a configuration in which a PNP transistor switch is connected between the oscillation loop of the piezo oscillator and the power supply voltage Vcc line with the collector and emitter in forward polarity, a first capacitor is connected between the base of the transistor and the power supply voltage Vcc line, and a second capacitor is connected between the base of the transistor and the ground; and

25 the quick start-up circuit begins to operate with a delay determined according to the rise of the power supply voltage Vcc after the application of power supply voltage Vcc and outputs a

start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc.

7. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

the quick start-up circuit has a configuration in which a PNP transistor switch is connected between the oscillation loop of the piezo oscillator and the power supply voltage Vcc line with the collector and emitter in forward polarity, a first capacitor is connected between the base of the transistor and the power supply voltage Vcc line, and a second capacitor is connected between the base of the transistor and the ground; and

the quick start-up circuit begins to operate at the timing controlled by the voltage division ratio of the voltage dividing circuit after the application of the power supply voltage Vcc and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc.

8. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

the quick start-up circuit has a first transistor switch, a voltage dividing circuit for base biasing of the first transistor

switch, and a second transistor switch which is turned ON and OFF by the output current of the first transistor switch; and

the quick start-up circuit begins to operate at the timing controlled by the voltage division ratio of the voltage dividing circuit after the application of the power supply voltage Vcc and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc.

9. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

the quick start-up circuit has a first PNP transistor switch connected between the oscillation loop of the piezo oscillator and the power supply voltage Vcc line with the collector and emitter in forward polarity, a first capacitor connected between the base of the first PNP transistor and the power supply voltage Vcc line, a second capacitor connected between the base of the first PNP transistor and the ground, and a second transistor switch which is turned ON and OFF by the output current of the first PNP transistor switch; and

the quick start-up circuit begins to operate with a delay according to the rise of the power supply voltage Vcc after the application of the power supply voltage Vcc and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc.

10. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

5 the quick start-up circuit has a first PNP transistor switch connected between the oscillation loop of the piezo oscillator and the power supply voltage Vcc line with the collector and emitter in forward polarity, a first capacitor connected between the base of the first PNP transistor and the power supply voltage Vcc line, a
10 second capacitor connected between the base of the first PNP transistor and the ground, and a second transistor switch which is turned ON and OFF by the output current of the first PNP transistor switch; and

the quick start-up circuit begins to operate at the timing controlled by the capacitance ratio of the first and second capacitors after the application of the power supply voltage Vcc and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc.

11. A piezo oscillator characterized in that:

20 the oscillating circuit contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

the quick start-up circuit has a first PNP transistor switch
25 connected between the oscillation loop of the piezo oscillator and the power supply voltage Vcc line with the collector and emitter in forward polarity, a first capacitor connected between the base of

the first PNP transistor and the power supply voltage Vcc line, and a second capacitor connected between the base of the first PNP transistor and the ground;

the quick start-up circuit begins to operate with a delay according to the rise of the power supply voltage Vcc after the application of the power supply voltage Vcc and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc; and

the quick start-up circuit further has a transistor switch which turns ON at about the same time as the turning-ON of the first PNP transistor between the base of the first PNP transistor and the ground.

12. A piezo oscillator characterized in that:

the oscillating circuit contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

the quick start-up circuit has a first PNP transistor switch connected between the oscillation loop of the piezo oscillator and the power supply voltage Vcc line with the collector and emitter in forward polarity, a first capacitor connected between the base of the first PNP transistor and the power supply voltage Vcc line, and a second capacitor connected between the base of the first PNP transistor and the ground;

the quick start-up circuit begins to operate with a delay according to the rise of the power supply voltage Vcc after the application of the power supply voltage Vcc and outputs a start-up

quickenning voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc; and

the quick start-up circuit has a PNP transistor which turns ON at about the same time at the timing of the turning-ON of the first PNP transistor between the base of the first PNP transistor and the ground;

the quick start-up circuit begins to operate at the timing controlled by the capacitance ratio of the first and second capacitors after the application of the power supply voltage Vcc and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc; and

the quick start-up circuit further has a transistor switch which turns ON at about the same time as the turning-ON of the first PNP transistor between the base of the first PNP transistor and the ground.

13. A piezo oscillator characterized in that:

the oscillating circuit contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

the quick start-up circuit has a first PNP transistor switch connected between the oscillation loop of the piezo oscillator and the power supply voltage Vcc line with the collector and emitter in forward polarity, a first capacitor connected between the base of the first PNP transistor and the power supply voltage Vcc line, a second capacitor connected between the base of the first PNP transistor and the ground, and a second transistor switch which is

turned ON and OFF by the output current of the first PNP transistor switch;

the quick start-up circuit begins to operate with a delay according to the rise of the power supply voltage Vcc after the application of the power supply voltage Vcc and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage Vcc; and

the quick start-up circuit further has a transistor switch which turns ON at about the same time as the turning-ON of the first PNP transistor between the base of the first PNP transistor and the ground.

14. A piezo oscillator characterized in that:

the oscillating circuit contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage Vcc;

the quick start-up circuit has a first PNP transistor switch connected between the oscillation loop of the piezo oscillator and the power supply voltage Vcc line with the collector and emitter in forward polarity, a first capacitor connected between the base of the first PNP transistor and the power supply voltage Vcc line, a second capacitor connected between the base of the first PNP transistor and the ground, and a second transistor switch which is turned ON and OFF by the output current of the first PNP transistor switch;

the quick start-up circuit begins to operate at the timing controlled by the capacitance ratio of the first and second

capacitors after the application of the power supply voltage V_{cc} and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage V_{cc} ; and

the quick start-up circuit further has a transistor switch which turns ON at about the same time as the turning-ON of the first PNP transistor between the base of the first PNP transistor and the ground.

15. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, amplifying circuit, and quick start-up circuit for applying a start-up quickening voltage of a desired level to one terminal of the piezo resonator after the application of power supply voltage V_{cc} ;

the quick start-up circuit has a transistor switch and a voltage dividing circuit for base biasing of the transistor switch which has a series circuit of a capacitor and a resistor; and

the quick start-up circuit begins to operate at the timing controlled by the time constant of the series circuit and outputs a start-up quickening voltage with a steeper rise than the rise characteristics of the power supply voltage V_{cc} .

16. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, and quick start-up circuit; and

the quick start-up circuit functions to increase the collector current of the oscillating transistor for a predetermined length of time after the application of power supply voltage V_{cc} in order to shorten the start-up time of the piezo oscillating circuit and stops functioning after the predetermined length of time.

17. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor connected between the emitter of the oscillating transistor and the ground, and quick start-up circuit; and

the quick start-up circuit functions to decrease the impedance across the emitter resistor for a predetermined length of time after the application of power supply voltage V_{cc} in order to shorten the start-up time of the piezo oscillator.

18. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor connected between the emitter of the oscillating transistor and the ground, and quick start-up circuit; and the quick start-up circuit contains a switch circuit and connects both ends of the emitter resistor by the switch circuit for a predetermined length of time after the application of power supply voltage V_{cc} to decrease the resistance between the emitter of the oscillating transistor and the ground and shorten the start-up time of the piezo oscillator.

19. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor connected between the emitter of the oscillating transistor and the ground, and quick start-up circuit; and

the quick start-up circuit contains a switch circuit and a switch control circuit, and the switch control circuit controls the ON and OFF operation of the switch circuit according to the

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Charging current of a capacitor to short-circuit both ends of the emitter resistor by the switch circuit for a predetermined length of time after the application of power supply voltage V_{cc} and thereby decrease the resistance between the emitter of the oscillating transistor and the ground and shorten the start-up time of the piezo oscillator.

20. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor connected between the emitter of the oscillating transistor and the ground, and quick start-up circuit;

the quick start-up circuit contains a switch circuit and a switch control circuit;

the switch circuit contains a second transistor whose collector is connected to the emitter of the oscillating transistor and whose emitter is connected to the ground;

the switch control circuit contains a third transistor whose collector is connected to the power supply voltage V_{cc} line, whose base is connected to the power supply voltage V_{cc} line through a capacitor, and whose emitter is connected to the base of the second transistor through a resistor; and

the ON and OFF operation of the switch circuit is controlled by the charging current of the capacitor so as to short-circuit both ends of the emitter resistor for a predetermined length of time after the application of the power supply voltage V_{cc} and thereby decrease the resistance between the emitter of the

oscillating transistor and the ground and shorten the start-up time of the piezo oscillator.

21. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor connected between the emitter of the oscillating transistor and the ground, and quick start-up circuit;

the quick start-up circuit contains a switch circuit and a switch control circuit;

the switch circuit contains a second transistor whose collector is connected to the emitter of the oscillating transistor through a resistor and whose emitter is connected to the ground;

the switch control circuit contains a third transistor whose collector is connected to the power supply voltage V_{cc} line, whose base is connected to the power supply voltage V_{cc} line through a capacitor, and whose emitter is connected to the base of the second transistor through a resistor; and

the ON and OFF operation of the switch circuit is controlled by the charging current of the capacitor so as to short-circuit both ends of the emitter resistor for a predetermined length of time after the application of the power supply voltage V_{cc} and thereby decrease the resistance between the emitter of the oscillating transistor and the ground and shorten the start-up time of the piezo oscillator.

22. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, and quick start-up circuit; and

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Fig. 16
the quick start-up circuit functions to pull up the voltage of the collector of the oscillating transistor for a predetermined length of time after the application of power supply voltage V_{cc} and thereby increase the collector current and shorten the start-up time of the piezo oscillator, and stops functioning after the predetermined length of time.

23. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor connected between the collector of the second transistor and the power supply voltage V_{cc} line, and quick start-up circuit;

the quick start-up circuit functions to pull up the collector voltage of the second transistor for a predetermined length of time after the application of power supply voltage V_{cc} ; and

the resulting rise in the collector voltage of the oscillating transistor causes an increase in the collector current of the oscillating transistor which makes the piezo resonator begin to vibrate forcibly and thereby shortens the start-up time of the piezo oscillator.

24. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor connected between the collector of the second transistor and the power supply voltage V_{cc} line, and quick start-up circuit;

the quick start-up circuit contains a switch circuit;

the switch circuit turns ON for a predetermined length of time after the application of power supply voltage Vcc to connect the collector of the oscillating transistor or the collector of the second transistor to the power supply voltage Vcc line with a small resistance; and

the resulting rise in the collector voltage of the oscillating transistor causes an increase in the collector current of the oscillating transistor which makes the piezo resonator begin to vibrate forcibly and thereby shortens the start-up time of the piezo oscillator.

25. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor connected between the collector of the second transistor and the power supply voltage Vcc line, and quick start-up circuit;

the quick start-up circuit contains a switch circuit and a switch control circuit;

the switch control circuit contains a capacitor and is activated by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage Vcc to turn the switch circuit ON;

the switch circuit, while it is ON, connects the collector of the oscillating transistor or the collector of the second transistor to the power supply voltage Vcc line with a small resistance; and

the resulting rise in the collector voltage of the oscillating transistor causes an increase in the collector current of the oscillating transistor which makes the piezo resonator begin to vibrate forcibly and thereby shortens the start-up time of the piezo oscillator.

26. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor connected between the collector of the second transistor and the power supply voltage Vcc line, and quick start-up circuit;

the quick start-up circuit contains a switch circuit and a switch control circuit;

the switch circuit has a configuration in which the emitter of a PNP transistor is connected to the power supply voltage Vcc line, the collector of the PNP transistor is connected to the collector of the oscillating transistor or to the collector of the second transistor;

the switch control circuit has a configuration in which the collector of a third transistor is connected to the base of the PNP transistor, the base of the third transistor is connected to the power supply voltage Vcc line through a capacitor and to the ground through a diode in reverse polarity, and the emitter of the third transistor is connected to the ground through a resistor;

the switch control circuit is activated by the charging current of the capacitor for a predetermined length of time after

the application of power supply voltage V_{cc} to turn the switch circuit ON;

the switch circuit, while it is ON, connects the collector of the oscillating transistor or the collector of the second transistor to the power supply voltage V_{cc} line with a small resistance; and

the resulting rise in the collector voltage of the oscillating transistor causes an increase in the collector current of the oscillating transistor which makes the piezo resonator begin to vibrate forcibly and thereby shortens the start-up time of the piezo oscillator.

27. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor connected between the collector of the second transistor and the power supply voltage V_{cc} line, and quick start-up circuit;

the quick start-up circuit contains a switch circuit and a switch control circuit;

the switch circuit has a configuration in which the emitter of a PNP transistor is connected to the power supply voltage V_{cc} line, the collector of the PNP transistor is connected to the collector of the oscillating transistor or the collector of the second transistor;

the switch control circuit has a configuration in which the collector of a third transistor is connected to the base of the PNP transistor and to the power supply voltage V_{cc} line through a

resistor, the base of the third transistor is connected to the power supply voltage Vcc line through a capacitor and to the ground through a diode in reverse polarity, and the emitter of the third transistor is connected to the ground through a resistor;

5 the switch control circuit is activated by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage Vcc to turn the switch circuit ON;

10 the switch circuit, while it is ON, connects the collector of the oscillating transistor or the collector of the second transistor to the power supply voltage Vcc line with a small resistance; and

15 the resulting rise in the collector voltage of the oscillating transistor causes an increase in the collector current of the oscillating transistor which makes the piezo resonator begin to vibrate forcibly and thereby shortens the start-up time of the piezo oscillator.

28. A piezo oscillator characterized in that:

20 the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor and collector resistor of the oscillating transistor, and quick start-up circuit;

25 the quick start-up circuit functions to connect the emitter of the oscillating transistor to the ground with a small resistance and connect the collector of the oscillating transistor to the power supply voltage Vcc line for a predetermined length of time after the application of the power supply voltage Vcc, and the

resulting increase in the collector current of the oscillating transistor shortens the start-up time of the piezo oscillator; and the quick start-up circuit stops functioning after the predetermined length of time, and the collector current of the oscillating transistor decreases to the normal value.

29. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor, and quick start-up circuit;

the quick start-up circuit functions to connect the emitter of the oscillating transistor to the ground with a small resistance and connect the collector of the oscillating transistor or of the second transistor to the power supply voltage V_{cc} line with a small resistance for a predetermined length of time after the application of the power supply voltage V_{cc} , which causes an increase in the collector current of the oscillating transistor and thereby shortens the start-up time of the piezo oscillator; and

the quick start-up circuit stops functioning after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

30. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor and collector resistor of the oscillating transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits:

one switch circuit connects the emitter of the oscillating transistor to the ground with a small resistance, and the other switch circuit connects the collector of the oscillating transistor to the power supply voltage Vcc line with a small resistance;

the switch circuits of the quick start-up circuit are turned ON for a predetermined length of time after the application of power supply voltage Vcc, and the resulting increase in the collector current of the oscillating transistor shortens the start-up time of the piezo oscillator; and

the switch circuits of the quick start-up circuit are turned off after the predetermined length of time, and the collector current of the oscillating transistor decreases to the normal value.

31. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits: one switch circuit connects the emitter of the oscillating transistor to the ground with a small resistance, and the other switch circuit connects the collector of the oscillating transistor or of the second transistor to the power supply voltage Vcc line with a small resistance;

the switch circuits of the quick start-up circuit are turned ON for a predetermined length of time after the application of

power supply voltage V_{cc} , and the resulting increase in the collector current of the oscillating transistor shortens the start-up time of the piezo oscillator; and

the switch circuits of the quick start-up circuit are turned off after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

32. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor and collector resistor of the oscillating transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits and a switch control circuit;

the switch control circuit contains a capacitor and is activated to turn the switching circuits ON by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage V_{cc} ;

when being ON, one of the switch circuits connects the emitter of the oscillating transistor to the ground with a small resistance, and the other switch circuit connects the collector of the oscillating transistor to the power supply voltage V_{cc} line with a small resistance, which causes an increase in the collector current of the oscillating transistor and thereby shortens the start-up time of the piezo oscillator; and

the switch circuits are turned off after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

33. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits and a switch control circuit;

the switch control circuit contains a capacitor and is activated to turn the switching circuits ON by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage Vcc;

when being ON, one of the switch circuits connects the emitter of the oscillating transistor to the ground with a small resistance, and the other switch circuit connects the collector of the oscillating transistor or of the second transistor to the power supply voltage Vcc line with a small resistance, which causes an increase in the collector current of the oscillating transistor and thereby shortens the start-up time of the piezo oscillator; and

the switch circuits are turned off after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

34. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor and collector resistor of the oscillating transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits and a switch control circuit;

one of the switch circuits has a configuration in which the collector of a second transistor is connected to the emitter of the oscillating transistor and the emitter of the second transistor is connected to the ground;

5 the other switch circuit has a configuration in which the emitter of a PNP transistor is connected to the power supply voltage Vcc line and the collector of the PNP transistor is connected to the collector of the oscillating transistor;

10 the switch control circuit has a configuration in which the emitter of a third transistor is connected to the base of the second transistor through a resistor, the collector of the third transistor is connected to the base of the PNP transistor, and the base of the third transistor is connected to the power supply voltage Vcc line through a capacitor and to the ground through a diode in reverse polarity;

15 the switch control circuit is activated by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage Vcc to turn the switch circuits ON;

20 the switch circuits, when being ON, connect the emitter of the oscillating transistor to the ground with a small resistance and connect the collector of the oscillating transistor to the power supply voltage Vcc line with a small resistance; and

25 the switch circuits are turned off by the switch control circuit after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

35. A piezo oscillator characterized in that:

Fig. 2
the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits and a switch control circuit;

one of the switch circuits has a configuration in which the collector of a third transistor is connected to the emitter of the oscillating transistor and the emitter of the third transistor is connected to the ground;

the other switch circuit has a configuration in which the emitter of a PNP transistor is connected to the power supply voltage V_{cc} line and the collector of the PNP transistor is connected to the collector of the oscillating transistor or the collector of the second transistor;

the switch control circuit has a configuration in which the emitter of a fourth transistor is connected to the base of the third transistor through a resistor, the collector of the fourth transistor is connected to the base of the PNP transistor, and the base of the fourth transistor is connected to the power supply voltage V_{cc} line through a capacitor and to the ground through a diode in reverse polarity;

the switch control circuit is activated by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage V_{cc} to turn the switch circuits ON;

the switch circuits, when being ON, connect the emitter of the oscillating transistor to the ground with a small resistance and connect the collector of the oscillating transistor or of the second transistor to the power supply voltage Vcc line with a small
5 resistance; and

the switch circuits are turned off by the switch control circuit after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

36. A piezo oscillator characterized in that:

10 the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor and collector resistor of the oscillating transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits and a switch control circuit;

15 one of the switch circuits has a configuration in which the collector of a second transistor is connected to the emitter of the oscillating transistor and the emitter of the second transistor is connected to the ground;

20 the other switch circuit has a configuration in which the emitter of a PNP transistor is connected to the power supply voltage Vcc line and the collector of the PNP transistor is connected to the collector of the oscillating transistor;

25 the switch control circuit has a configuration in which the emitter of a third transistor is connected to the base of the second transistor through a resistor, the collector of the third transistor is connected to the base of the PNP transistor and to the power supply voltage Vcc line through a resistor, and the base

of the third transistor is connected to the power supply voltage Vcc line through a capacitor and to the ground through a diode in reverse polarity;

the switch control circuit is activated by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage Vcc to turn the switch circuits ON;

the switch circuits, when being ON, connect the emitter of the oscillating transistor to the ground with a small resistance and connect the collector of the oscillating transistor to the power supply voltage Vcc line with a small resistance; and

the switch circuits are turned off by the switch control circuit after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

37. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits and a switch control circuit;

one of the switch circuits has a configuration in which the collector of a third transistor is connected to the emitter of the oscillating transistor and the emitter of the third transistor is connected to the ground;

the other switch circuit has a configuration in which the emitter of a PNP transistor is connected to the power supply voltage Vcc line and the collector of the PNP transistor is connected to the collector of the oscillating transistor or the collector of the second transistor;

the switch control circuit has a configuration in which the emitter of a fourth transistor is connected to the base of the third transistor through a resistor, the collector of the fourth transistor is connected to the base of the PNP transistor and to the power supply voltage Vcc line through a resistor, and the base of the fourth transistor is connected to the power supply voltage Vcc line through a capacitor and to the ground through a diode in reverse polarity;

the switch control circuit is activated by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage Vcc to turn the switch circuits ON;

the switch circuits, when being ON, connect the emitter of the oscillating transistor to the ground with a small resistance and connect the collector of the oscillating transistor or of the second transistor to the power supply voltage Vcc line with a small resistance; and

the switch circuits are turned off by the switch control circuit after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

38. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor and collector resistor of the oscillating transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits and a switch control circuit;

one of the switch circuits has a configuration in which the collector of a second transistor is connected to the emitter of the oscillating transistor through a resistor and the emitter of the second transistor is connected to the ground;

the other switch circuit has a configuration in which the emitter of a PNP transistor is connected to the power supply voltage Vcc line and the collector of the PNP transistor is connected to the collector of the oscillating transistor;

the switch control circuit has a configuration in which the emitter of a third transistor is connected to the base of the second transistor through a resistor, the collector of the third transistor is connected to the base of the PNP transistor and to the power supply voltage Vcc line through a resistor, and the base of the third transistor is connected to the power supply voltage Vcc line through a capacitor and to the ground through a diode in reverse polarity;

the switch control circuit is activated by the charging current of the capacitor for a predetermined length of time after the application of power supply voltage Vcc to turn the switch circuits ON;

the switch circuits, when being ON, connect the emitter of the oscillating transistor to the ground with a small resistance and

connect the collector of the oscillating transistor to the power supply voltage Vcc line with a small resistance; and

the switch circuits are turned off by the switch control circuit after the predetermined length of time to let the collector current of the oscillating transistor decrease to the normal value.

39. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor, second transistor connected to the oscillating transistor in cascade, collector resistor of the second transistor, and quick start-up circuit;

the quick start-up circuit has at least two switch circuits and a switch control circuit;

one of the switch circuits has a configuration in which the collector of a third transistor is connected to the emitter of the oscillating transistor through a resistor and the emitter of the third transistor is connected to the ground;

the other switch circuit has a configuration in which the emitter of a PNP transistor is connected to the power supply voltage Vcc line and the collector of the PNP transistor is connected to the collector of the oscillating transistor or the collector of the second transistor;

the switch control circuit has a configuration in which the emitter of a fourth transistor is connected to the base of the third transistor through a resistor, the collector of the fourth transistor is connected to the base of the PNP transistor and to the power supply voltage Vcc line through a resistor, and the base

of the fourth transistor is connected to the power supply voltage Vcc line through a capacitor and to the ground through a diode in reverse polarity;

the switch control circuit is activated by the charging
5 current of the capacitor for a predetermined length of time after the application of power supply voltage Vcc to turn the switch circuits ON;

the switch circuits, when being ON, connect the emitter of the oscillating transistor to the ground with a small resistance and
10 connect the collector of the oscillating transistor or of the second transistor to the power supply voltage Vcc line with a small resistance; and

the switch circuits are turned off by the switch control circuit after the predetermined length of time to let the collector
15 current of the oscillating transistor decrease to the normal value.

40. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, and quick start-up circuit; and

the quick start-up circuit controls the collector current and
20 the emitter current of the oscillating transistor by means of current regulating circuits in a current mirror configuration only for a predetermined length of time after the application of the power supply voltage Vcc.

41. A piezo oscillator characterized in that:

25 the piezo oscillator contains a piezo resonator, oscillating transistor, and two quick start-up circuits;

Fig. 1
a first quick start-up circuit applies a start-up quickening voltage to the piezo resonator only for a predetermined length of time after the application of the power supply voltage Vcc; and

5 a second quick start-up circuit increases the collector current of the oscillating transistor only for a predetermined length of time after the application of the power supply voltage Vcc.

42. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, and two quick start-up circuits;

the quick start-up circuits each have one or more switch circuits;

Fig. 2
a first quick start-up circuit applies the power supply voltage Vcc to the piezo resonator as a start-up quickening voltage through the switch circuit only for a predetermined length of time after the application of the power supply voltage Vcc; and

15 a second quick start-up circuit bypasses^{an} (the) emitter resistor, (the) collector resistor, or both of the oscillating transistor through the switch circuit or switch circuits to increase the collector current of the oscillating transistor only for a predetermined length of time after the application of the power supply voltage Vcc.

43. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, buffer transistor connected to the oscillating transistor in cascade;

the base of the buffer transistor is connected to the power supply voltage Vcc line through a first capacitor; and

the base of the buffer transistor is connected to the ground through a second capacitor.

5 44. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor, and quick start-up circuit;

the quick start-up circuit has a switch circuit using a depletion type p-channel FET for the switch device;

the switch circuit turns ON only for a predetermined length of time after the application of power supply voltage Vcc to connect both ends of the emitter resistor and thereby increase the start-up current to the piezo resonator; and

the switch circuit turns OFF after the predetermined length of time.

45. A piezo oscillator characterized in that:

the piezo oscillator contains a piezo resonator, oscillating transistor, emitter resistor of the oscillating transistor, and quick start-up circuit;

the quick start-up circuit has a configuration in which the base of a depletion type p-channel FET is connected to the power supply voltage Vcc line, the gate of the depletion type p-channel FET is connected to between a resistor and a capacitor connected in series between the power supply voltage Vcc line and the ground, and the source to drain of the depletion type p-channel FET is

connected in parallel with the emitter resistor of the oscillating transistor;

the depletion type p-channel FET turns ON only for a predetermined length of time after the application of power supply voltage V_{cc} to connect both ends of the emitter resistor and thereby increase the start-up current to the piezo resonator; and

the depletion type p-channel FET turns OFF after the predetermined length of time.

Added
a.